

PROCAMBARUS (ORTMANNICUS) ATTIGUUS, A
NEW TROGLOBITIC CRAYFISH
(DECAPODA: CAMBARIDAE) FROM THE
SAINT JOHNS RIVER BASIN, FLORIDA

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Abstract. — *Procambarus (Ortmannicus) attiguus*, an albinistic troglobite, is described from Silver Glen Springs, 14.4 km northwest of Astor Park, Marion County, Florida. Its closest affinities are with *P. (O.) delicatus* Hobbs & Franz, the two sharing several unusual characteristics, including enlarged third maxillipeds, with the monotypic Floridian troglobite *Troglocambarus maclanei* Hobbs. The combination of denticles on the opposable margin of the ischium of the enlarged third maxilliped and the areola less than 20 times as long as broad distinguishes the new species from other members of the Cambaridae.

Procambarus (Ortmannicus) attiguus, described herein from Silver Glen Springs, Marion County, Florida, is another crayfish sharing a character (enlarged third maxillipeds) that prior to the discovery of *Procambarus (Ortmannicus) delicatus* Hobbs & Franz (1986) was believed to be unique to the monotypic *Troglocambarus maclanei* Hobbs, 1942. As in *P. (O.) delicatus*, however, there are denticles (lacking in *T. maclanei*) on the opposable margin of the ischium of this appendage that are fewer in number, more delicate, and more acute than in other troglobitic or epigean cambarids. The new species is the only member of the subfamily Cambarinae, except for *T. maclanei*, that at least sometimes lacks a posterior arthrobranch on segment XIII, that bearing the fourth pereopod. The sometimes absence of this gill, the broader areola, and the reduced (not visible in dorsal aspect) pouch-like protrusion on the anteroventral surface of the branchiostegites distinguish this crayfish from its closest relative, *P. (O.) delicatus*.

Procambarus (Ortmannicus) attiguus,
new species

Diagnosis. — Albinistic; eyes reduced and without facets or pigment. Rostrum lacking

marginal spines and median carina. Carapace with reduced pouch-like protrusions in anteroventral branchiostegal regions but lacking cervical spines. Areola 13.6 to 15.9 times as long as broad and constituting 40.0 to 41.7% of total length of carapace (49.7–51.9% of postorbital carapace length). Suborbital angle absent. Postorbital ridge without spines or tubercles. Antennal scale about 1.7 times as long as broad, broadest distal to midlength. Third maxillipeds enlarged, opposable margin of ischium with 7 to 9 denticles and as many as 8 small tubercles or spines laterally, distolateral extremity with spine. Ischia of third and fourth pereopods with digitiform hooks, that of third overreaching basioischial articulation, neither opposed by tubercle on corresponding basis; coxa of fourth pereopod with prominent boss, that of fifth lacking boss. First pleopods of first form male asymmetrical, reaching coxae of third pereopods; distal extremity lacking subapical setae but bearing: spiculiform mesial process, which directed distolaterally and slightly inclined caudally, reaching about same distance distally as central projection; cephalic process tapering, acute, directed distally but weakly bowed cephalically, its apex falling short of apex of central projection; caudal process, smallest of terminal elements, slender, acute,

directed distally, and reaching slightly beyond midlength of central projection; and latter, largest of terminal elements, blade-like, acute, and disposed distally but inclined slightly caudally. Annulus ventralis freely movable, subovate, about 1.7 times as broad as long, completely exposed even though preannular sternite with 2 pairs of low elevations flanking caudal margin; convex ventral surface with prominent median longitudinal furrow much expanded, especially dextrally, posterior to midlength; flanking dextral ridge with large, anteriorly situated depression, narrower sinistral one broken by oblique furrow anterior to midlength; sinus, with anterior extremity situated in cephalic part of furrow, extending caudally and slightly sinistrally across median line before gently curving caudodextrally far beyond median line where turning caudosinistrad and ending near caudal margin of annulus slightly dextral to median line; fossa scarcely evident but situated at about midlength of sinus. Postannular sclerite approximately 0.7 as broad as annulus and about 0.5 as long. First pleopod of female represented by very small tuberculi-form rudiment.

Holotypic male, form I.—Cephalothorax subovate in cross section, weakly depressed (Fig. 1a, d). Abdomen slightly narrower than thorax (10.0 and 12.3 mm). Greatest width of carapace greater than height at caudodorsal margin of cervical groove. Areola 15.9 times as long as wide with room for 1 or 2 punctations in narrowest part. Cephalic section of carapace 2.4 times as long as areola, length of latter 41.7% of entire length of carapace (51.9% of postorbital carapace length). Rostrum with convergent, non-thickened margins. Acumen, not clearly delimited basally, reaching base of ultimate podomere of antennular peduncle; dorsal surface excavate and sparsely punctate. Subrostral ridge weak and evident in dorsal aspect only at base, joining lateral rostral carina at about midlength of penultimate podomere of antennular peduncle (Fig. 1a,

d). Postorbital ridges lacking spines and tubercles. Cervical spines lacking, tubercles in area no larger than others on branchiostegites. Branchiostegal spines absent. Almost entire surface of carapace except for dorsomedian and extreme anterolateral areas granulate. Paired pouchlike protrusions on anteroventral branchiostegal region present but much less conspicuous than in *Procambarus (O.) delicatus* and not visible in dorsal aspect of carapace.

Abdomen only slightly shorter than carapace. Pleura of third through fifth abdominal segments rounded anteroventrally, subangular posteroventrally. Cephalic section of telson with single fixed spine in each caudolateral corner. Cephalic lobe of epistome (Fig. 1e) subtriangular, with cephalolateral margins weakly elevated (ventrally); main body with depressed anteromedian area bearing distinct fovea; epistomal zygoma broadly arched.

Ventral surface of proximal podomere of antennular peduncle with submedian spine distal to midlength. Antennal peduncle lacking spines and tubercles but acute angle present on distolateral margin of basis; flagellum extending beyond caudal margin of telson by more than length of latter. Antennal scale (Fig. 1o) 1.7 times as long as broad, widest distinctly distal to midlength, and lamellar area about 3 times as wide as thickened lateral part. Right mandible (Fig. 1h) with incisor ridge bearing 10 denticles, cephalic molar process very weakly corneous, shallowly concave; caudal molar process with 3 cusps, 2 of which corneous-tipped, at angles of triangle. Third maxillipeds (Fig. 1a, k) enlarged, overreaching rostrum by combined length of dactyl, propodus, and little more than half that of carpus; ischium with lateral margin bearing 6 (sinistral) or 9 (dextral) spiniform tubercles; opposable margin with 7 (dextral) or 9 (sinistral) spiniform denticles; lateral half of ventral surface with clusters of minute setae; exopod reaching base of distal fourth of merus.

Left chela (Fig. 1j. Note: many tubercles

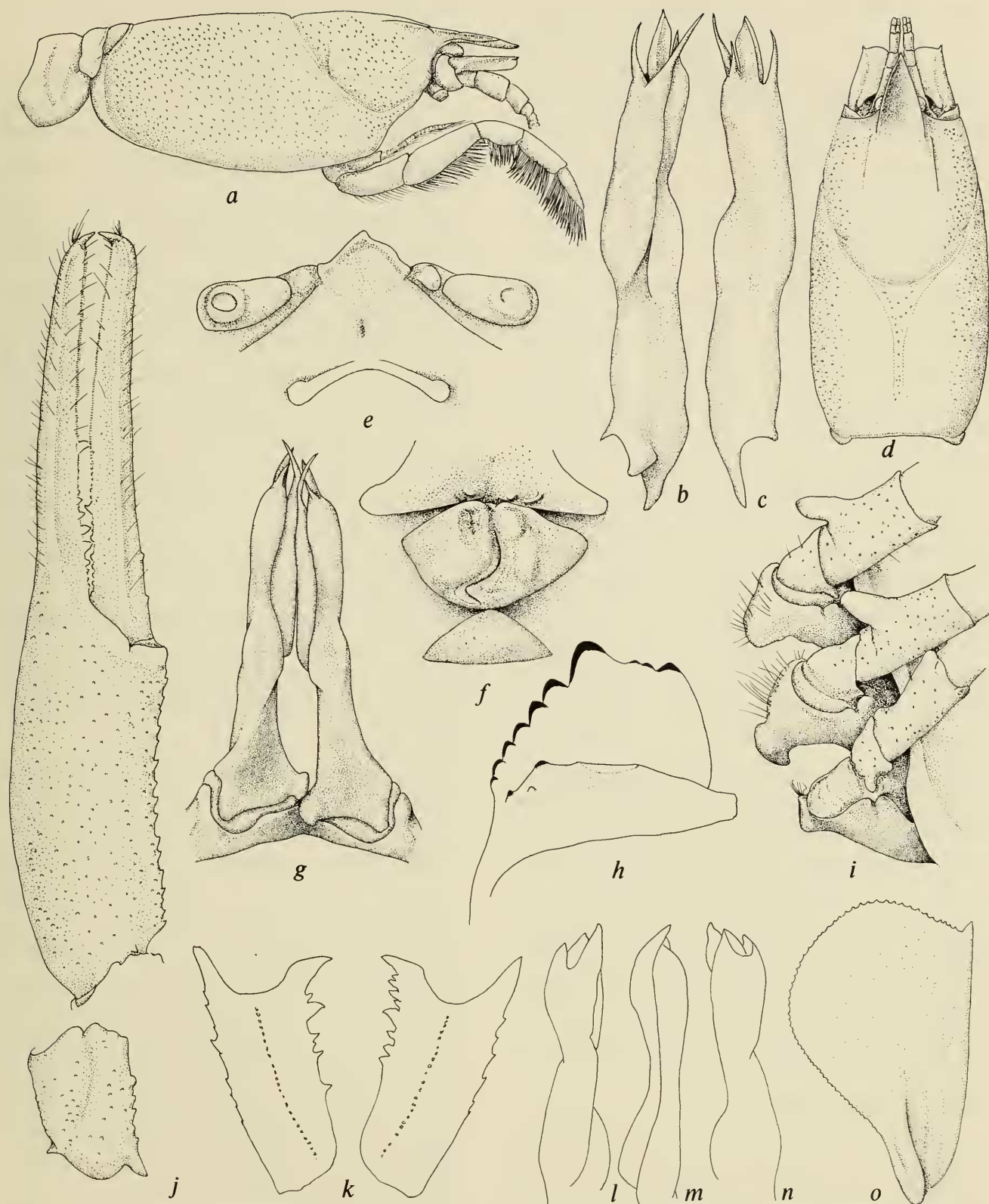


Fig. 1. *Procambarus (O.) attiguus*, new species (all from holotype except f from allotype and l-n from form II exuvia of holotype). a, Lateral view of carapace, basal podomeres of antenna, third maxilliped, and first two abdominal segments; b, Mesial view of left first pleopod; c, Lateral view of same; d, Dorsal view of carapace; e, Epistome and part of basal antennal podomere; f, Annulus ventralis and adjacent sternal elements; g, Caudal view of first pleopods; h, Caudal view of dextral mandible; i, Basal podomeres (coxa-ischium) of third, fourth, and fifth pereiopods; j, Dorsal view of distal podomeres (carpus-dactyl) of left cheliped; k, Ventral (postaxial) view of ischia of third maxillipeds; l, Mesial view of first pleopod; m, Caudal view of same; n, Lateral view of same; o, Antennal scale.

enumerated in the description are too small to be included in the illustration) subovate in cross section, not strongly depressed. Mesial surface of palm with at least 3 irregular rows of 12–15 tubercles, some of which acute; other surfaces also studded with tubercles. Fingers provided with well-defined ridges dorsally and ventrally; dorsal ridges flanked by few small tubercles proximally and by setiferous punctations along remainder of fingers. Opposable margin of fixed finger with 2 rows of tubercles: upper consisting of 10 tubercles (fifth and sixth from base subequal in size and larger than others) extending from base of finger almost to base of middle third of length; lower row of 4 tubercles (third from base decidedly largest) in middle third of finger (corresponding numbers on right chela 15 and 5); longitudinal band of minute denticles extending between more distal tubercles and continuing uninterrupted to base of corneous tip of finger; lateral margin of finger with row of 3 small tubercles along proximal sixth followed by row of setiferous punctations. Opposable margin of dactyl with 2 rows of tubercles: upper of 20 (sixth from base largest) along proximal half of finger and lower row of 4 (proximalmost largest) in distal part of proximal half of finger (corresponding numbers on right chela 18 and 4); longitudinal band of minute denticles extending between tubercular rows and beyond, reaching base of corneous tip; mesial margin of dactyl with only 2 tubercles representing usual row, these followed distally by row of setiferous punctations.

Carpus of left cheliped (Fig. 1j) longer than broad, tuberculate; prominent subacute tubercles on median ventrodistal margin, that on ventrolateral condyle no larger than others nearby; shallow oblique sulcus on dorsal surface flanked by squamous tubercles.

Merus of left cheliped studded with tubercles except mesially and laterally where sparse except distally. Usual mesial and lateral rows on ventral surface irregular but consisting of 30 or 33 tubercles of varying,

not graduated, sizes. Ischium with row of 6 tubercles along mesial margin.

Hooks on ischia of third and fourth pereopods (Fig. 1i) digitiform, that on third overreaching basioischial. Coxa of fourth pereopods with prominent boss; no boss present on coxa of fifth pereopod.

Sternum between third and fourth pereopods moderately deep; ventrolateral margins setiferous but not forming conspicuous mat; sternite between fifth (not “fourth” as erroneously noted in the description of *P. (O.) delicatus*, Hobbs & Franz, 1986:512) pereopods not produced in conspicuous, median, tuberculiform prominence. First pleopods (Fig. 1b, c, g) as described above in “Diagnosis.” First pleopod from exuviae of holotype (see Fig. 1l, m, n), although somewhat distorted, revealing features of appendage of second form male. Uropods with both lobes of basal podomere ending in spines; distomedian spine on mesial ramus situated some distance proximal to distal margin of ramus. (See Table 1 for measurements.)

Branchial count, determined from exuvia of holotype, 17 + ep.

Allotypic female.—Excluding secondary sexual features, allotypic female differing from holotype as follows: areola 13.6 times as long as wide and comprising 40.3% of postorbital length; apex of rostrum reaching midlength of ultimate podomere of antennular peduncle; pouchlike protrusions on cephaloventral region of branchiostegites reduced, even less noticeable; mandible with 11 denticles on incisor ridge; opposable margins of ischia of right and left third maxillipeds with 7 and 9 spiniform denticles, respectively; chelipeds missing. See “Diagnosis” for description of annulus ventralis and adjacent sternal area (Fig. 1f). (Also, see Table 1.)

Notes on the paratypic juvenile female.—This specimen was obviously involved in an unfortunate mishap. All of the appendages, except the mandibles through the second maxillipeds, have been subjected to

some degree of mutilation and most bear at least regenerative buds. The rostrum is slightly longer than those of the primary types and, although apically abraded, almost reaches the end of the antennular peduncle. Also, the cephalic section of the telson bears a small movable spine immediately mesial to the fixed dextral one. The branchial series was examined only on the right side and, unlike the holotype, lacks a posterior arthrobranch at the base of the fourth pereopod. As noted in Table 1, other slight differences occur in the proportions of features of the carapace.

Type locality.—Silver Glen Springs, 9 mi (14.4 km) northwest of Astor Park, Marion County, Florida (SE ¼, NE ¼, SE ¼, Sec. 25 T.14S, R. 26E). The springs at Silver Glen are located in a semicircular pool which forms a wide spring run that flows eastward into Lake George and the St. Johns River. Most of the flow discharges from two large openings, although some water emerges from numerous sand boils in the main spring run and in a small tributary that enters the pool on the southwest side. A large vertical solution tube, known as the “Natural Well,” discharges water from a small cave passage into the northwest corner of the pool. The entrance to the main system lies in approximately 6.5 m of water on the northeast side of the spring pool. The initial passage is a tight maze that opens into a large room approximately 55 m from the entrance. The passage from the Natural Well entrance intercepts the main cave through a large breakdown pile of limestone rubble on the floor of this room. The main cave continues to a large room about 213 m from the main entrance. The floor of this room is at a water depth of 49 m; the ceiling is at 15 m.

The crayfish were found in the latter room where several were sequestered in small crevices in the walls. Two individuals, however, were seen floating in the water column about 30 m above the floor and were presumably displaced from the ceiling by bubbles of air escaping from the divers’ regu-

Table 1.—Measurements (mm) of *Procambarus (O.) attiquus*, new species.

	Holo- type	Allo- type	Para- type
Carapace			
Entire length	26.2	23.6	17.0
Postorbital length	21.4	19.1	13.6
Width	12.3	10.6	7.5
Height	11.0	9.2	6.9
Areola			
Width	0.7	0.7	0.5
Length	11.1	9.5	6.8
Rostrum			
Width	4.2	3.1	2.3
Length	5.5	5.9	3.7
Left Chela			
Length, palm mesial margin	10.0		
Palm width	5.2		
Length, lateral margin	25.5		
Dactyl length	14.4		
Abdomen			
Width	10.0	8.4	6.6
Length	25.6	22.5	18.2

lators. One individual was observed on an extensive flocculence of reddish organic material, possibly bacterial growth, on a breakdown slope near the floor of the room. Others were seen moving on the bottom away from these clusters. Because of the strong outflow, there is no visible accumulation of organic detritus anywhere in the cave. Unidentified amphipods were seen in the cave and large numbers of redeye chubs (*Notropis harperi*) were observed in sheltered areas throughout the cave. American eels (*Anguilla rostrata*), large shrimps (*Macrobrachium carcinus*), and blue crabs (*Callinectes sapidus*) occurred at both major cave vents, but were not observed in the cave. Striped bass (*Morone saxatilis*), which frequently appear in the vicinity of the main entrance, followed the divers on several occasions deep into the cave system.

Passages in this system exhibit strong outflows of water, making entry very difficult. An average discharge of 112 ft³ (3.1 m³)/sec

and a maximum outflow of 129 ft³ (3.7 m³)/sec in April 1935 were reported by Rosenau et al. (1977). Like other spring discharges in the Lake George area, the chemical composition of Silver Glen Springs water includes high concentrations of calcium, magnesium, sodium, sulfates, and chlorides (see Rosenau et al. (1977).

The Silver Glen Springs cave system is believed to have developed along the contact between the (Miocene) Hawthorn Group and the older (Eocene) Ocala Limestones. Both entrances and the maze portion of the main cave are in sediments that may represent the Coosawhatchee Formation. According to Scott (1988), this is the upper formation in the Hawthorn Group and lies above the Marks Head and Penney Farms formations. He also noted that in the vicinity of Lake George, the Hawthorn Group sequence of sediments is compressed into a thin layer probably no more than 75 ft (22.9 m) thick. It rests unconformably on the Ocala Limestones, probably the Crystal River Formation, approximately 300 m below the surface.

The specimens were collected by Tom Morris on 6 February and 16 August 1990 and were maintained in aquaria until they died, the holotype (following three molts) on 13 January 1991. A more detailed account of the locality and of the maintenance of the specimens is being prepared by the second author and Tom Morris in their review of the troglobitic crayfishes of the St. Johns River Basin.

Disposition of types. — The holotypic male, form I, the allotype, and the juvenile female paratype are deposited in the National Museum of Natural History (Smithsonian Institution), numbers 220683, 220684, 220685, respectively.

Size. — The holotype is the largest of the three known specimens. Its carapace length is 26.6 mm, its postorbital carapace length 21.4 mm. Corresponding lengths of the allotypic female are 23.6 and 19.1 mm.

Range. — This crayfish is known only from the type locality.

Relationships. — There seems to be no question that this new crayfish has its closest affinities with *Procambarus (Ortmannicus) delicatus* and, more distantly, with *Troglocambarus maclanei*. It shares so many features in common with *delicatus* that we have some reluctance in choosing not to consider the specimens at hand to be conspecific with the latter, the only known representatives of which were taken from nearby Alexander Springs, Lake County — the two populations are separated by no more than 15 air miles. But the crucial features of the first pleopod of the first form male of *delicatus* are unknown, the species having been described on the basis of two second form males and a female. Inasmuch as there are several features that make the specimens from Silver Glen Springs readily distinguishable from those of *delicatus* from Alexander Springs and the likelihood that the first pleopod of first form males of the latter (when they become available) will reveal further differences we have decided to recognize the two populations as representing distinct species. The features that set these three specimens apart from *delicatus* are as follows: thorax less inflated and not quite so strongly tuberculate; areola 13.6 to 15.9 (as opposed to 25.5 to 30.7) times as long as broad, and constituting 40.0 to 41.7% (as opposed to 43.8 to 46.6%) of total length of carapace; mandible with major denticle on incisor ridge fourth or fifth (as contrasted with third) from lateral side; opposable margin of ischium of third maxilliped with row of 7 to 9 (as opposed to 5 to 7) denticles; pouch-like protrusions on anteroventral branchiostegal region much reduced and not visible in dorsal aspect; mesial process of first pleopod of second form male more robust and cephalic process comparatively longer (viewed laterally overreaching midlength of centrocephalic process of central projection, as opposed to falling short of midlength);

annulus ventralis somewhat more quadrangular than ovate.

The enlarged third maxillipeds and the absence of a posterior arthrobranch at the base of the fourth pereopod in the paratype align this crayfish with *Troglocambarus maclanei*; these are the only species assigned to the Cambarinae in which this gill has been observed to be lacking. As noted above, it is present in an exuvia of the holotype, so whether or not the absence of the gill is a unique feature of the paratypic female, the only specimen from which the branchiostegite was removed, needs to be confirmed.

The relationships of *P. (O.) delicatus* to other southeastern troglobitic crayfishes and their epigeal relatives were discussed by Hobbs & Franz (1986) and the opinions expressed are equally applicable to *P. (O.) delicatus*. The previously known troglobites were treated in their review of the crayfishes of Florida by Franz & Franz (1990) and Hobbs & Hobbs (1991).

Etymology.—*Attiguus* (L.) = neighboring; alluding to the proximity of the type, and only known, localities of the new species and *P. (O.) delicatus* as well as to the close kinship of these crayfishes.

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